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SOME EFFECTS OF RELEASE ON PLANTED SHORLEAF PINE

IN THE MISSOURI OZARKS

By

Richard D. Lane, Field Assistant
and
Franklin G. Liming, Assistant Conservationist^{1/}

Planting in the recently established National Forests in the Missouri Ozarks has been, and apparently will continue to be, confined largely to the underplanting of stands of undesirable species with shortleaf pine. It is recognized that many of these plantations will have to be released if a satisfactory growth rate of the pine is to be maintained. An opportunity to obtain some preliminary information on the effects of various types and amounts of release on planted shortleaf pine was provided in connection with studies on methods of controlling sprouting. Data on the growth and mortality of planted pine on these sprouting study plots, taken at the end of the first growing season after release, are presented in this progress report.

The Studies

The treatment of the overstory in these studies included three methods of killing the tops of the trees, applied at four intensities and at three different times of the year. Because of the difficulties encountered in finding a uniform area sufficiently large to accommodate all combinations of these three variants, it was necessary to divide the study and to use two similar areas. One of these areas is located in Howell County on the Willow Springs Ranger District and the other in Reynolds County on the Salem Ranger District. Both areas are gently rolling and supported fairly dense stands of blackjack oak saplings and poles.

On the Willow Springs Ranger District the study consisted of two replications of four methods of treatment (including the check) made at three seasons of the year, thus using a total of 24 tenth-acre plots. The four methods of treatment were: (1) cutting, the removal

^{1/} John L. Arend and B. F. Seizert, Junior Foresters in CCC camps on the Mark Twain and Clark National Forests, assisted with the field work on these studies.

of all of the overstory trees, providing an immediate release; (2) notch-girdling, the killing of all of the trees by the removal of a ring of bark and sapwood, thus bringing about a gradual release during the first year; (3) peel-girdling, the gradual killing of all of the trees by the removal of a ring of bark without cutting into the wood, thus bringing about a gradual release during the first two or more years; and (4) check, no trees were killed and consequently no release was made. These treatments were made at three seasons of the year: (1) dormant season, in February before growth started; (2) early growing season, in May during the active growth period; and (3) late growing season, during August after the major part of the height growth had taken place.

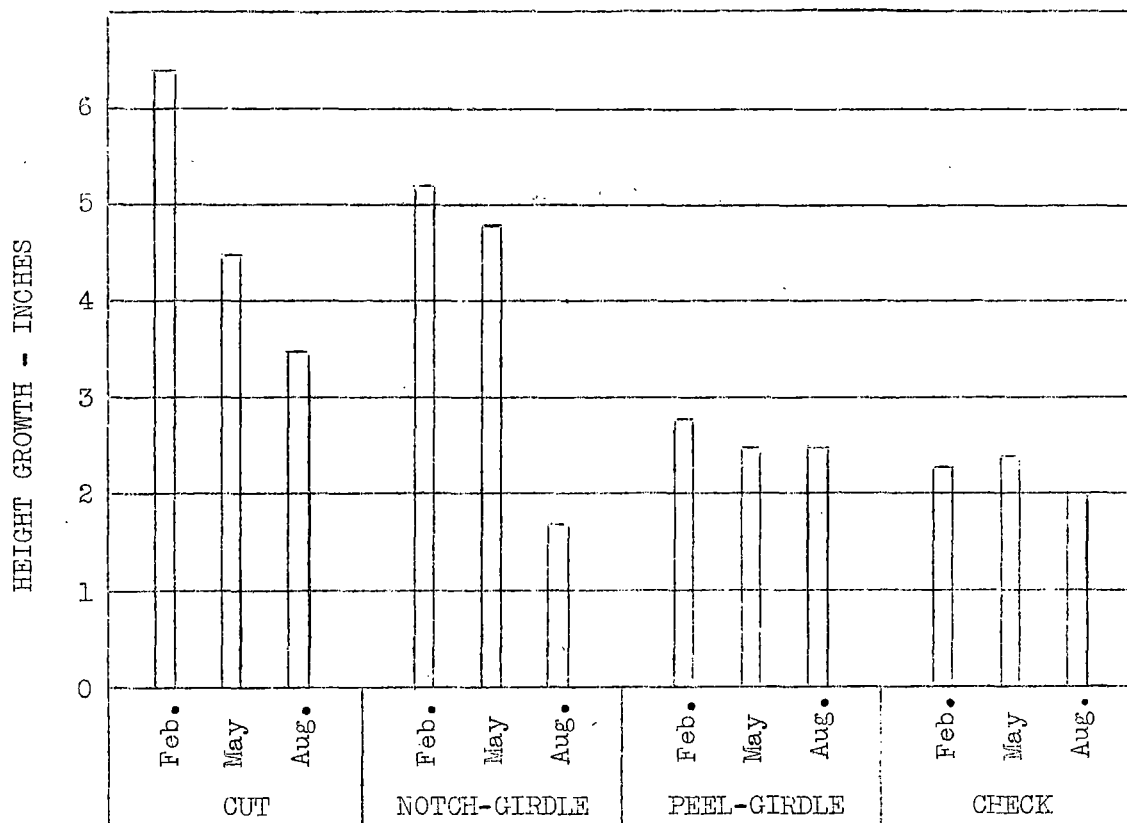
The study on the Salem Ranger District consisted of three replications of three methods of treatment applied at four intensities during the dormant season. The methods of treatment (cut, notch-girdle and peel-girdle) were the same as those used in the Willow Springs study. The four intensities of release were: (1) 100 percent release, all of the trees in the overstory were treated; (2) 67 percent release, a sufficient number of the trees were treated so that the basal area^{2/} of the untreated trees on each plot was one-third of the average basal area of the overstory trees on all of the plots; (3) 33 percent release, two-thirds of the average basal area was left untreated; and (4) no release, none of the trees was treated.

Results

The average 1938 height growth of the 810 one-year shortleaf pine seedlings planted on the plots on the Willow Springs Ranger District in the spring of 1938, the year during which the treatments were made, is shown graphically, by methods and months of treatment, in Figure 1. Although ultimately all methods and months of treatment will result in a 100 percent release there was a great variation in the amounts and rates of effective release during the first growing season. Complete release accompanied removal of the overstory trees by cutting and was effective over periods of approximately eight, five and two months on the plots treated in February, May and August, respectively. Release brought about by notch and peel-girdling was gradual and was only about 60 and 10 percent effective, respectively, by the end of the growing season. There was, of course, no release on the check plots.

The height growth of the pine increased with an increase in the length of growing season after treatment for all methods of release. The trend was steep and regular for treatment made by cutting; was steep but irregular for releases made by notch-girdling; and, was nearly flat and statistically insignificant for releases made by peel-girdling and for the check plots.

2/ There was a close correlation between the basal area and the crown area of the overstory trees used in this study.



METHODS AND MONTHS OF TREATMENT

Figure 1,- The 1938 height growth of 1-0 shortleaf pine planted on the Willow Springs Ranger District in the spring of 1938 and released at intervals during the 1938 growing season.

The height growth of the pine released in February averaged 6.4 inches on plots released by cutting, 5.2 for notch-girdling, 2.8 for peel-girdling and 2.3 on the untreated plots. This varies directly with the amounts of release, which were approximately 100, 60, 10, and 0 percent, respectively, at the end of the first growing season. The growth rates of the pine released by cutting and notch-girdling in May (see Figure 1 again) were approximately equal, and were greater than the growth rates on the plots released by peel-girdling and on the check plots. As would be expected, because of the short length of the remaining growing period, the differences in the effects of treatments in August were not as pronounced as in the other two seasons. The only significant increase occurred on the plots released immediately and completely by cutting.

The mortality of the pine on the release plots averaged approximately 16 percent as compared to 10 percent on the check plots. Although this represents a 60 percent increase in mortality it is statistically insignificant, because of the inconsistencies in the direction and degrees of variation and the large variations between plots receiving the same treatment.

The plots on the Salem Ranger District were planted with 1-0 shortleaf pine in the fall of 1936. About one-half of these died prior to the spring of 1938, when this study was initiated. The average 1938 height growth of 560 of the surviving individuals, distributed over all 36 plots, is shown graphically, by methods and intensities of treatment, in Figure 2. For all methods of release the height growth of the pine increased with an increase in the amount of release. In each instance, treatment of the last one-third of the overstory resulted in a greater increase in the growth of the pine than did the treatment of either the first or the second one-third. The increase in growth on the treated plots over that on the untreated plots was significant only on those released 100 percent. Within each intensity of treatment, the variations in height growth of the pine between methods of release were not significant.

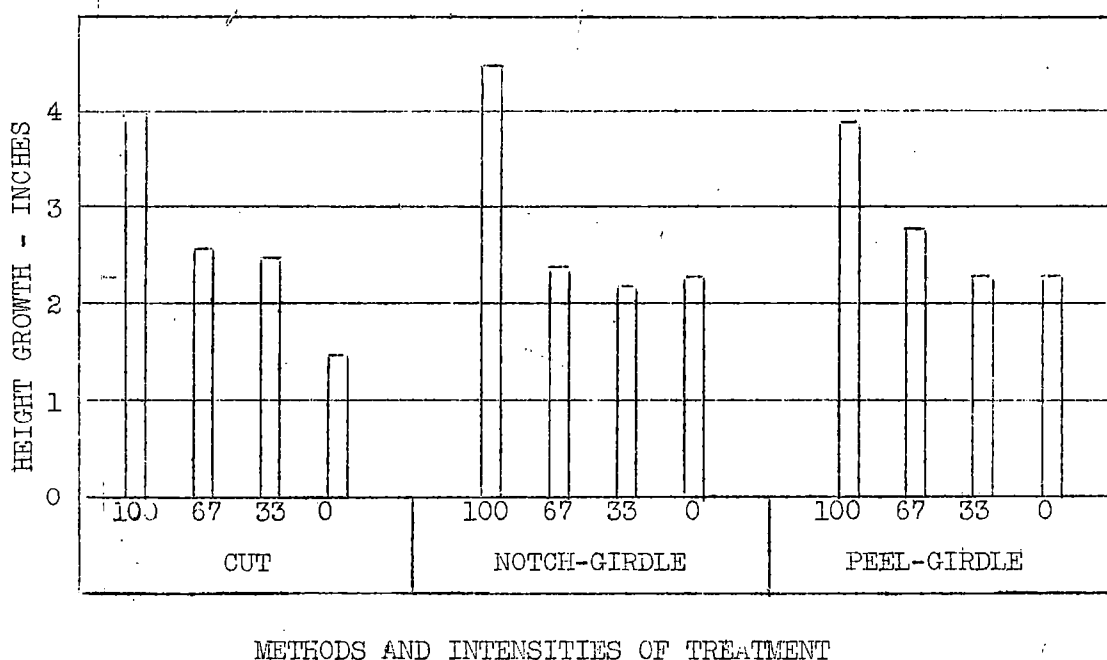


Figure 2.- 1938 height growth of 1-0 shortleaf pine planted on the Salem Ranger District in the fall of 1936 and released just prior to the 1938 growing season.

The average mortality of the pines on the released plots on the Salem area was approximately 15.5 percent as compared to 5 percent on unreleased plots. An unexpectedly high mortality of 88.5 percent on the plots released 100 percent by cutting was responsible for practically all of this increase and was the only treatment that gave a significant increase in mortality.

Discussion

The above results are based on data taken at the end of the first growing season after release and consequently may not be true indications of the ultimate effects of the different types of releases on the growth rate and mortality of planted pine. This is particularly true of those differences that have resulted from the two methods of girdling and the three months of treatment. During each succeeding growing season the differences in the densities of the overstory on those plots on which all trees were treated will decrease until each has been released 100 percent. Subsequent differences in the pine on these plots will then be due to difference in rate of release rather than the amount of release.

As was mentioned above, the pine on the Willow Springs area was planted in the spring of the year during which treatments were made, whereas that on the Salem area was released after having had one growing season in the field. There were no replications within age on either of these areas. However, since the two areas were quite similar, it is quite possible that some of the differences in the behavior of the pine that received similar treatment on the two areas may have been due to the difference in the age of the pine.

The large difference between the 11 percent and the 88 percent mortality on the clear-cut plots on the Willow Springs and Salem Ranger Districts, respectively, was considered of sufficient importance to justify the initiation of another study to ascertain more definitely the effects of release on the mortality in shortleaf pine plantations of different ages. The response of pine to release was greater on the Willow Springs area than on the Salem area. Likewise, the variation of height growth of the pine released by the different methods was significant on the Willow Springs area and not on the Salem area. Since, within each method of release the height growth of the pine on the Salem area increased with an increase in intensity of release, and since the overstory was less dense on the cut plots than on those treated by notch and peel-girdling, this failure of methods to show significant differences in height growth was unexpected.

Although the releases discussed in this paper are spoken of in terms of light, it is recognized that soil moisture is also an important factor in the survival and height growth of planted pine. It is quite possible that the three methods of release employed in this study do not bring about corresponding reductions in competition for light and moisture. The increase in the rate of photosynthesis in pine per unit increase in light is greater at the lower than at the higher intensities of light. The fact that the removal of the last one-third of the overstory resulted in a greater increase in the growth rate of pine than did the removal of either the first or second one-third raises the question as to whether light is the limiting factor. Likewise, a difference in the light and moisture requirements for pine during the first and second growing seasons after planting may explain the differences in growth

rate of the pine on the two areas. It is possible to obtain some practical information on the release of pine by considering light and moisture collectively. However, if the differences in the behavior of released pine are to be fully explained, it will be necessary to consider light and moisture separately and find out to what extent each is a limiting factor.

Summary

The behavior of the 1-0 shortleaf pine planted on the Willow Springs Ranger District in the spring of 1938 and released by cutting, notch-girdling and peel-girdling the overstory trees during February, May and August of the same year is summarized as follows:

- (1) The height growth of the pine varied directly with the length of the growing season after treatment.
- (2) The growth rate of the pine varied inversely with the density of the overstory brought about by the three methods of release.
- (3) Although the mortality of the pine was increased 60 percent by treatment, the variations between seasons within each treatment and between treatments within each season were not significant.

On the Salem Ranger District the 1-0 shortleaf pine was planted in the fall of 1936 and was released in the spring of 1938 by cutting, notch-girdling and peel-girdling 0, 33, 67, and 100 percent of the overstory. The pine responded as follows:

- (1) The height growth of the pine increased with an increase in the intensity of release for all three methods.
- (2) In each instance treatment of the last one-third of the overstory resulted in a greater increase in height growth than did treatment of either the first or second one-third.
- (3) The variation in height growth of the pine between methods was not significant within any of the intensities of treatment.
- (4) The mortality of the pine was tripled by release due primarily to the unexpectedly high mortality on the plots released 100 percent by cutting.
- (5) Release of pine the same year it was planted resulted in a greater increase in height growth and a lower mortality due to treatment than when released after having had one growing season in the field.

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